

3.2

Simple and Compound Interest

When you deposit money into a savings or investment account, you earn interest from your financial institution because you are lending them your money. When you borrow money, you must pay interest to the financial institution. The interest you pay is compensation to the lender for the use of their money.

Simple interest is based on the original amount, or **principal**, invested or borrowed. Interest is usually stated as a certain percentage per annum (per year). Simple interest is often used for personal loans and short-term investments. The time in years for the investment or loan is called the **term** of the investment.

If you keep the interest earned in your account, new interest may be paid on the principal plus that interest. This is called **compound interest**. Compound interest can be paid more than once a year. The interest rate is stated per annum and is divided by the number of **compounding periods** per year. For example, if the interest rate is compounded:

- semi-annually (twice a year), divide the interest rate by 2;
- quarterly (four times a year), divide the interest rate by 4;
- monthly (twelve times a year), divide the interest rate by 12;
- daily (365 times a year), divide the interest rate by 365.

Simple and Compound Interest

Terms:

1. Principle - the amount of money that is invested
2. Term - how long in years for an investment or loan
3. Compounding period - how often interest is calculated (annually, semi annually, quarterly, monthly, daily)
4. Simple Interest - interest calculated as a percentage of the principle

Simple Interest Formula: $I = Prt$

I - interest

P - principle

r - annual interest rate (decimal form)

t - the term of the investment

Ex. Bill invests \$25000 for 4 years at an interest rate of 3.5% per year.

A. How much interest will Bill have after 4 years?

$$\begin{aligned} I &= Prt \\ &= (25000)(0.035)(4) \\ &= \$3500 \end{aligned}$$

B. How much money will Bill have in 4 years?

$$\begin{aligned} &25000 + 3500 \\ &= \$28500 \end{aligned}$$

Example 1

Gordon wants to invest \$2000.00. His bank offers an investment option that earns simple interest at a rate of 1.75% per year.

- a) If he invests the money for 1 year, how much interest will Gordon earn?
- b) If he invests the money for 2 years, how much interest will Gordon earn?
- c) Based on your answers above, write an equation that can be used to calculate simple interest.

$$\begin{aligned} a) \quad I &= Prt \\ &= (2000)(0.0175)(1) \\ &= \$35 \end{aligned}$$

$$b) \$70 \quad c)$$

Compound Interest - interest that is paid on the principle plus the interest (earn interest on interest)

Compound Interest Formula:

$$A = P \left(1 + \frac{r}{n}\right)^{nt}$$

$$A = P(1 + r/n)^{nt}$$

A = final value of the investment

P = principle

r = interest rate expressed as a decimal

n = the number of compounding periods in a year

t = the term of the investment in years

Example 1:

Natasha invests \$25000 for 4 years at a rate of 3.5% compounded semi annually.

A. How much money will Natasha have in 4 years?

$$\begin{aligned} A &= P \left(1 + \frac{r}{n}\right)^{nt} \\ &= 25000 \left(1 + \frac{0.035}{2}\right)^{2 \cdot 4} \\ &= 25000 (1.0175)^8 \\ &= 25000 (1.149) = \$28722.45 \end{aligned}$$

B. How much interest will Natasha have earned in 4 years?

$$\begin{aligned} &28722.45 - 25000 \\ &= \$3722.45 \end{aligned}$$

2. Amy invests \$5000 at 2% interest compounded quarterly for 6 years. How much money will Amy have at the end of 6 years and how much of it will be interest?

Example 2

Allison wants to invest \$2000.00. Her bank offers an investment option that earns compound interest at a rate of 1.75% per year, compounded annually.

- a) If she invests the money for 1 year, how much interest will Allison earn?
- b) If she invests the money for 2 years, how much money will Allison have at the end of the investment term?
- c) Would you use the method from part b) for calculating the total value if Allison decides to invest her money for 10 years? Why or why not?

Example 3

Calculate the final value of an initial investment of \$6000.00. Interest is paid at 4.00% per annum, compounded semi-annually, for 3 years. Record your calculations in a table with the following headings: interest period; investment value at the beginning of period (\$); interest earned (\$); and investment value at end of period (\$).

If you have this, show me NOW:

-Pg.95 Questions #1-4

-Pg. 98-99 Activity 3.2 #1-3

-Pg. 102 #5,6

Please take out Pg. 112 #1, 6

$$\underline{I} = Prt$$

$$A = P \left(1 + \frac{r}{n} \right)^{n \cdot t}$$

BUILD YOUR SKILLS

1. Gerard has a savings account at a credit union in Tignish, PEI. Gerard deposits \$2000.00 into a savings account that pays 3.00% simple interest per annum.
- $3.00 \div 100 = 0.03$
- a) Calculate the interest that Gerard will earn on his savings after 2 years.
- b) How much money will Gerard have in his account after 2 years if he makes no withdrawals?

$$\begin{aligned} 1. a) \quad I &= Prt \\ &= (2000)(0.03)(2) \\ &= \$120 \end{aligned}$$

$$b) \quad 2000 + 120 = \$2120$$

Rule of 72

- a quick method of estimating the time it takes for an investment to double value

To determine how long it would take you to double your money if compounded annually, divide 72 by the interest rate.

Ex. 6% interest

$72/6 = 12$ It would take approximately 12 years to double your money.

GIC - Guaranteed Investment Certificate

Your interest rate will not change over the term of the investment.

Rate is usually lower than other investments.

Pg. 112 # 2, 3, 4, 6bc, 7

2. Solve the following problems using the simple interest formula.
- If the interest earned on a deposit is \$50.00 and the interest rate is 3.00% per annum invested for 2 years, what is the principal?
 - How many months does it take to earn \$180.00 interest on an investment if the principal is \$5000.00 and the interest rate is 2.00% per annum?
 - Calculate the annual interest rate on an investment if the principal is \$4000.00 and the interest is \$120.00 earned over three years. Answer as a percent and a decimal.

= 2

$I = prt$ (0.03)(5000)(2)

2. Solve the following problems using the simple interest formula.

- a) If the interest earned on a deposit is \$50.00 and the interest rate is 3.00% per annum invested for 2 years, what is the principal?

$$\frac{I = P}{rt} \quad \frac{rt}{rt}$$

$$\begin{aligned} P &= \frac{I}{rt} \\ &= \frac{50}{(0.03)(2)} \\ &= \frac{50}{0.06} = \$833.33 \end{aligned}$$

$$\begin{aligned} I &= 50 \\ r &= 0.03 \\ t &= 2 \\ P &= ? \end{aligned}$$

- b) How many months does it take to earn \$180.00 interest on an investment if the principal is \$5000.00 and the interest rate is 2.00% per annum?

$$\frac{I}{Pr} = \frac{Pr t}{Pr}$$

$$t = \frac{I}{Pr} = \frac{180}{(5000)(0.02)} = \frac{180}{100}$$

$t = 1.8 \text{ years}$

$$\begin{aligned} I &= 180 \\ P &= 5000 \\ r &= 2.00\% \\ &= 0.02 \\ t &= ? \end{aligned}$$

$$12 \text{ months} \times 1.8 = 21.6 \text{ months}$$

$\sim 22 \text{ months}$

- c) Calculate the annual interest rate on an investment if the principal is \$4000.00 and the interest is \$120.00 earned over three years. Answer as a percent and a decimal.

$$\frac{I}{Pt} = \frac{Pr}{RA}$$

$$r = \frac{I}{Pt} = \frac{120}{12000} = 0.01 \times 100 = 1\%$$

3. Mei Lin borrowed \$1500.00 for vehicle repairs from her parents. She agreed to pay back the loan plus 6.50% simple interest on the \$1500.00 added on in equal monthly payments over the next 6 months.

a) How much interest will Mei Lin have to pay?

$$t = 0.5$$

b) What will be the total amount she will have to pay?

c) What will be her monthly payment for the loan?

$$\begin{aligned} a) \quad I &= Prt \\ &= 1500(0.065)(0.5) \\ &= \$48.75 \end{aligned}$$

$$\begin{aligned} b) \quad 1500 + 48.75 \\ &= \$1548.75 \end{aligned}$$

$$\begin{aligned} c) \quad \frac{1548.75}{6} \\ &= \$258.13 \end{aligned}$$

4. Use the Rule of 72 to estimate what interest rate would be needed to double your investment in 18 years.

$$\frac{72}{\text{interest rate}} = \text{Number of years it takes to double your money}$$

$$\frac{72}{x} = 18 \quad x = \frac{72}{18} = 4\%$$

12 % ? years

$$\frac{72}{12} =$$

$$\begin{array}{r} 72 \\ \hline 20 \\ \hline \end{array}$$

5. A deposit of $\overset{P}{\$1200.00}$ is invested at $\overset{r}{2.60\%}$ per annum, $\overset{n=2}{\text{compounded semi-annually}}$, for 2 years. $t=2$

- Explain why there are four interest periods.
- Calculate the interest earned and the investment value at the end of each interest period.
- What is the value of the investment at the end of 2 years?
- Calculate the interest earned over the 2 years.

$$\begin{aligned}
 A &= P \left(1 + \frac{r}{n} \right)^{nt} = 1200 \left(1 + \frac{0.026}{2} \right)^{2 \cdot 2} \\
 &= 1200 (1.013)^4 = 1200 (1.0532) \\
 &= \$1263.63
 \end{aligned}$$

6. Calculate the final investment value and the interest for each of the following investments.

a) \$2000.00 at 3.80% per annum, compounded semi-annually for four years. $\rightarrow 0.038$

b) \$1500.00 at 2.60% per annum, compounded quarterly for three years.

c) \$6000.00 at 2.20% per annum, compounded monthly for two years.

d) \$3560.00 at 1.20% per annum, compounded monthly for three months.

$$\begin{aligned} \text{b. a) } A &= P \left(1 + \frac{r}{n} \right)^{nt} \\ &= 2000 \left(1 + \frac{0.038}{2} \right)^{2(4)} = 2000 (1 + 0.019)^8 \\ &= 2000 (1.019)^8 \leftarrow \\ &= 2000 (1.16) \\ &= \$2325.00 \end{aligned}$$

- b) \$1500.00 at 2.60% per annum, compounded quarterly for three years.
- c) \$6000.00 at 2.20% per annum, compounded monthly for two years.

.

Pg. 112 #7

7. Which is the better investment? Investing \$2500.00 at 2.00% a year, compounded annually, for two years or \$2500.00 at 2.00% a year, compounded semi-annually, for two years? Explain your reasoning.